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# SNOMED CT as Reference Terminology in the Danish National Home Care Documentation Standard

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**Abstract.** In Danish home care, multiple professions deliver services to citizens. FSIII is a national home care documentation standard, where one of the goals is to share documentation to improve coordination between these professional groups and avoid double documentation. The aim of this study was to develop a SNOMED-CT based navigation hierarchy to ensure that professions could preserve their documentation practice, to help avoid double documentation, and to ensure that the technical implementation did not require sophisticated semantic tools. The method involved mapping of non-SNOMED-CT content to SNOMED CT, visualization of merged graphs, identification of reference concepts, relating reference concepts to the documentation models of each profession, and representation of the navigation hierarchy in a reference set. The navigation hierarchy ensures that citizen conditions appear in a relevant context, regardless of which profession entered the data. Our approach paves the way for incremental standardization projects, where an implementation artefact, such as the navigation hierarchy, highlights the semantic features of SNOMED CT that can be used to reach specific business goals; in this case, sharing data across professional groups.

**Keywords.** SNOMED CT, navigation hierarchy, national documentation standard

## 1. Introduction

In Danish home care, multiple professions deliver services to citizens. For example, home nurses deliver health- and care-related services. Assistants assist with functional problems e.g. helps with tasks related to washing, cleaning and eating. Physiotherapists deliver rehabilitation and training. These different services are delivered as specified by two different Danish national acts (the health act and the service act) by the 98 Danish municipalities. IT-systems called “home care records” have been developed to digitally support these activities. However, the systems are characterized by a “single municipality, single stakeholder” scope and are largely unstructured, which makes it difficult to make municipality-care citizen-centered and track outcomes of new treatment initiatives, but also makes it difficult to use collected data for national secondary purposes such as statistics and research.

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In 2007, the idea of standardizing the documentation models of Danish home care was first formulated and it was adopted into the different Danish digitalization strategies in the years 2011-2013. In 2013 the project, FSIII (Cross Terminology in Municipalities, version three), was launched. Development of the common documentation model has been undertaken from 2013-2016, and implementation in Danish home care records is scheduled for 2017.

### *1.1. FSIII Documentation Model with Focus on Conditions*

In current home care records, an unstructured to semi-structured description of the interventions that each professional group carry out, constitute the core part of the documentation following a visit. In FSIII, the point of departure will be citizen's health and functioning conditions. The idea is to focus care on the citizens' problems rather than the professional activities. In FSIII, it was decided to express a set of health conditions using SNOMED CT to support consistent recording of nursing related problems. This is described in our earlier work[1]. The health conditions are structured according to a national guideline for documenting nursing examinations with 12 nursing areas such as "nutrition", "skin and mucosa", "communication", "respiration and circulation" etc. These areas are well-recognized and used by the nursing profession in Denmark. However, from a semantic viewpoint the 12 areas are not well-defined; e.g. "respiration and circulations" are findings related to two entirely different body systems summarized in one nursing area.

Functioning conditions are used by assistants, and are recorded using a subset of ICF codes. ICF was chosen because the municipalities had already started using ICF to describe function. As part of the FSIII project, areas have been defined for the functional ability examination, so that assistants may structure their documentation under five areas e.g. "self-care abilities", "abilities related to carry out household chores", and "mental abilities".

In the years to come, additional condition sets are likely to be developed and included as part of FSIII, e.g. rehabilitation conditions as described by physiotherapists. In addition to conditions, a range of other attributes and value sets are also defined as part of the FSIII documentation model, e.g. patient demographics, interventions and intervention goals. However, any further description is omitted, because this paper focuses on the documentation of conditions, and how to handle the documentation overlap between professional groups.

### *1.2. Aim*

The aim of this study is to suggest an approach to solve the following implementation challenges in the FSIII project:

- Different professional groups use different terminologies, and different models for documentation. Preserving documentation practices that support each professional group, while still standardizing information content, is a challenge.
- Different professional groups have overlapping documentation e.g. both assistants and nurses need to know about nutrition. As a result, each profession documents a citizen's nutrition related problems to plan their interventions. Coordination only happens on an ad hoc basis.

- The current clinical information system landscape is immature when it comes to SNOMED CT implementation [2]. Consequently, expecting any sophisticated terminology use, such as semantic querying, would not be realistic.

## 2. Methods

### 2.1. SNOMED CT Representation of Non-SNOMED CT Concepts

To ensure that assistants can continue using ICF, but still have a homogeneous terminological representation, we mapped each of the 30 ICF concepts to a SNOMED CT concept. We used a common set of mapping guidelines, and aimed for predictable retrieval properties rather than semantic precision[3]. The mapping was done by two annotators, and each disagreement was discussed and resolved. The mapping table was represented as a simple map reference set, as specified by IHTSDO [4].

### 2.2. Visualization of Sets and Identification of Reference Concepts

We made a common hierarchical graph for both sets of FSIII conditions, to provide an overview of the involved concepts. We visualized each concept and its super-type concepts from the health and functioning condition sets respectively, and merged the graphs as described in [5]. From the merged graph we could identify common ancestors, that preserved the clinical meaning of a group of health and functioning condition, and we named these concepts “reference concepts”. Reference concepts can be understood as points of departure for predefined semantic queries i.e. from a clinical viewpoint it had to make sense to query for a reference concept and all its descendants within the FSIII condition sets. For example, it could make sense to query for all findings related to “activities of daily living” whether these findings were first documented by nurses or assistants. We ensured that each concept in the two condition sets, were subsumed by at least one reference concept, and if not, we added the concept itself as a reference concept.

### 2.3. Placing Reference Concepts in Each Professions Documentation Models

One objective of FSIII is to share information rather than document the same information twice. This means that nursing documentation should be informed by the documentation already made by assistants and vice versa. Consequently, it is not enough that nursing conditions are structured according to the 12 Danish nursing areas. Rather, *all* relevant FSIII conditions should be structured according to the 12 nursing areas and five functioning areas to ensure that regardless of e.g. nutrition being described by nurses or assistants, it is available when either group is looking for nutrition related information. Ideally, it would be possible to obtain a meaningful reference concept for each of the 12 nursing areas and the five functioning areas. However, given that the areas are semantically poorly defined, we instead placed a group of reference concepts under each area i.e. each area was defined by a SNOMED CT expression of the following pattern:  $Area_x = \langle\langle RC_1 \text{ OR } \langle\langle RC_2 \dots \text{ OR } \langle\langle RC_n \rangle\rangle \rangle\rangle$ , where *RC* is a reference concept.

## 2.4. Representing the Navigation Hierarchy as an Ordered Type Reference Set

Given the overview in the merged graph, we could predict exactly which conditions each area-expression would retrieve. As such, distributing just the expressions would be adequate if mature SNOMED CT infrastructures were available. However, to accommodate immature systems, we developed a navigation hierarchy that expressed which reference concepts belonged to each area, and which health and functioning conditions belonged to each reference concept. We represented the navigation hierarchy as an ordered type reference set. Implementation of this reference set means that systems can utilize the pre-defined area expressions to avoid double documentation without implementing all of SNOMED CT or semantic querying.

## 3. Results

Of the 30 assistant conditions and 44 nursing conditions, there were 5 full matches between the two sets. However, the sets had substantial semantic overlap caused by one professional group documented in more detail compared to the other. This was especially evident for the findings related to functioning where nurses typically use coarse-granular concepts, such as 365178001|Finding related to ability to perform personal care activity|, whereas assistants would have each personal care activity specified e.g. 365180007 | Finding related to ability to perform washing and drying activities| and 365222007 | Finding related to ability to perform dressing activity|. Non-overlaps were mostly seen for health conditions where only nurses could take action e.g. different types of ulcers and pain. The merged graph (in Danish) is shown in [6].

The areas were defined using expressions. For example, the nursing area “Nutrition” is defined by:

*Area<sub>nutrition</sub>* = <<107647005 |Weight finding| OR <<284648005 |Dietary intake finding| OR <<116336009 | Eating / feeding / drinking finding|

and the functioning area “Self-care ability” was defined by:

*Area<sub>self care</sub>* = <<365178001 |Finding related to ability to perform personal care activity| OR <<107647005 |Weight finding| OR <<284648005 |Dietary intake finding| OR <<116336009 | Eating / feeding / drinking finding| OR 130969003 | Health seeking behavior|

The two presented expressions overlap meaning that if citizen information is related to any concepts in the three semantic groups related to nutrition i.e. <<107647005 |Weight finding|, <<284648005 |Dietary intake finding|, <<116336009 | Eating / feeding / drinking finding| this information should be shown when nurses try to get an overview of nutrition, and when assistants try to get an overview of self-care regardless of whom documented the information in the first place. Consequently, we can preserve the documentation practice of each professional group, while still viewing the information documented by other professional groups.

The navigation hierarchy was represented by a modified ordered type reference set, as specified by IHTSDO [4]. We replaced the referenced ComponentId and linkedId by sourceId, sourceRefset, destinationId and destinationRefset to allow the source and targets to come from either of the involved sets e.g. reference concepts, health conditions and functioning conditions because the whole idea was to relate the concepts of the different sets, which is outside the scope of a traditional ordered type reference set. The

navigation hierarchy, as well as the other reference sets and classifications related to FSIII are distributed to care record vendors by Local Government Denmark.

#### 4. Discussion

In this study, we developed a navigation hierarchy that supports utilization of SNOMED CT as a reference terminology to bridge documentation of a citizen's conditions when entered by different professional groups using different terminologies and classifications. Whereas others have described the development of SNOMED CT reference sets for local, national or international use e.g. [7-9], terminology artefacts to ease implementation of SNOMED CT are much less common. The developed navigation hierarchy is an example of such an artefact. In the future, systems that use SNOMED CT artefacts might need to invest in sophisticated terminology management systems that allows mapping between classifications and semantic querying, and such systems are emerging; see e.g. the description of different solutions in [10]. However, most current clinical systems only allow very simple use of SNOMED CT. While waiting for more semantically sophisticated systems, national development towards semantic interoperability and better utilization of health related data continue. The developed navigation hierarchy demonstrates a pragmatic solution given international recommendations of incremental standardization e.g. [11]. Future studies await implementation projects by Danish vendors in 2017, to evaluate how the SNOMED CT based artefacts are adapted and used in the Danish home care records.

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